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APPARATUS AND METHOD FOR SECURING WIRES OF A ROTOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application is related to United States patents 5,625,244 and 5,886,451, the contents of which are incorporated herein by reference thereto.

TECHNICAL FIELD

The present invention relates generally to rotors for electrical machines, and more specifically to a method and apparatus for securing the wires for the field-generating coils of such rotors.

BACKGROUND

In many electrical machines, a rotor includes an electromagnetic field-generating coil which rotates with the rotor. In such machines, slip rings are typically provided as a part of the rotor assembly. The slip rings and their associated brushes provide a means for connecting the field-generating coil to a source of electrical current.

Connection of the field-generating coil to the slip rings can present reliability improvement opportunities in the design of a rotor for an electrical machine.

Therefore, wire routing designs for electrical machine rotors which can provide improved reliability and reduced cost are desirable.

SUMMARY

The present invention provides a method and apparatus for securing the connection between the slip ring and the coil of a rotor for an electrical machine.

Therefore, and in accordance with an exemplary embodiment of the present invention, a fan and a pair of slip rings are integrated into a unitary assembly, which cooperatively with the rotor shaft of the machine, provides for simple routing and single point termination for rotor coil leads. The slip ring assembly includes a pair of slip rings and corresponding terminal extending axially therefrom. A respective one of the coil leads is coupled to each slip ring terminal. The resulting connections are secured to the surface of the fan with a retaining member. The retaining member covers the joint and is ultrasonically welded to the surface of the fan.

The above-described and other features and advantages of the present invention will be appreciated and understood by those skilled in the art from the following detailed description, drawings, and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view of an alternator;

Figure 2 is a cross-sectional view of the rotor assembly;

Figures 3 and 4 are cross-section views of ultrasonic welding points on the fan of an alternator;

Figures 5-8 illustrate an alternator slip ring assembly;

Figures 9-11 illustrate the connection of a slip ring assembly and a coil;

Figures 12-14 illustrate a cap constructed in accordance with an exemplary embodiment of the present invention;

Figure 15 is a view along the lines 15-15 of Figure 2;

Figure 16 is an enlarged view of Figure 1; and

Figure 17 is a cross-sectional view of an alternative rotor assembly.

DETAILED DESCRIPTION

An alternator 10 is shown in cross-section in Figure 1. Alternator 10 has a rotor assembly 12 (Figure 2) and a stator assembly 14. Rotor assembly 12 includes a shaft 16 supporting rotating magnetic circuit structures thereof including, pole members 18 and 20, a rotor core 22, and a field coil 24 wound upon a bobbin 26. In addition, all other non-magnetic circuit rotating structures are also carried by shaft 16, including air circulation fans 28 and 30 located at axially opposite sides of pole members 18 and 20, and a slip ring assembly 32 located at one end of shaft 16.

Fan 30 is formed from sheet metal stock and is secured to pole member 20 by a securement means such as spot welding. Fan 28 is formed from an appropriate thermoplastic material and is heat-staked to power extensions (not shown) from the field coil bobbin 26. Shaft 16 is rotatably supported within a housing 34 by a pair of bearings 36 and 38. Bearing 36 is located between slip ring assembly 32 and fan 28.

Coil leads 40 of field coil 24 are wrapped about respective posts 42 of bobbin 26. Coil leads 40 pass through openings 44 in fan 28. (See also Figure 17).

Slip ring assembly 32 has a pair of copper rings 46, each having a slip ring lead 48 joined by welding or brazing thereto.

The copper rings and wires are molded into a thermoset or thermoplastic material to complete the slip ring assembly. Slip ring assembly 32 is pressed onto the end of rotor shaft 16, and the slip ring leads 48 are routed into channels positioned along shaft 16 where they are joined to coil leads 40 of field coil 24 by twisting and welding to form a joint 50.

Joint 50 is then bent to the surface of fan 28 and is secured thereto by heat staking. Bearing 36 is assembled to pass over slip ring assembly 32 and retain the lead wires 48 securely within the shaft channels.

Referring now to Figures 3 and 4, a securement member 54 is illustrated. Securement member 54 provides a means for securing joint 50 to fan 28. Securement member 54 is positioned to receive and secure joint 50 to fan 28. Typically, fan 28 is molded with a pair of securement members 54. Each securement member has a pair of tab portions 56 that depend outwardly from the surface of fan 28 and which defines a receiving area 58.

Accordingly, and after joint 50 is formed and bent towards the surface of fan 28, and in particular into receiving area 58 of securement member 54, tabs 56 are heat-staked to secure joint 50 to fan 28 (Figure 4).

This type of securement is permanent and provides the necessary durability to joint 50. Moreover, such a means of securement is completely destroyed if, for example, slip ring assembly 32 is removed from shaft 16.

This is particularly true in applications where alternator 10 is being rebuilt and the surface of a slip ring assembly 32 has become worn or damaged. This may be caused by the brushes of the alternator continuously making contact with the surface of slip ring assembly 32. Accordingly, and in order to rebuild alternator 10, it may be necessary to remove and replace the slip ring assembly. Once the slip ring assembly has been removed and joint 50 has been pulled from its staked position in fan 28 (Figure 4), it is no longer possible to heat-stake joint 50 to fan 28, as there simply is not enough excess material to heat-stake the joint to the surface of fan 28.

Referring now to Figures 5-16, and in accordance with an exemplary embodiment of the present invention, the securement of a new joint 50 to fan 28 is illustrated. A new slip ring assembly 32 is prepared for insertion onto shaft 16 (Figures 5-8).

Slip ring assembly leads 48 are lined up with coil leads 40 (Figure 9), then twisted together (Figure 10) and welded to form a new joint 50.

Once the leads are twisted and welded together, the same are bent towards the surface of fan 28 (Figure 11). A retaining member 60 (Figures 12-14) is now secured to fan 28 over joint 50. Retaining member 60 replaces support member 54. Retaining member 60 is manufactured out of a nylon material capable of being heat-staked to fan 28.

In an exemplary embodiment, retaining member 60 defines an inner receiving area 62. Receiving area 62 is sufficiently large enough to accommodate joint 50 while allowing retaining member 60 to be secured to fan 28.

Retaining member 60 has a pair of end portions 64 which are connected to each other by a pair of leg members 66. Leg members 66 are secured to each other at one end, and to end portions 64 at the other. Leg portions 66 are configured to traverse upwardly and away from end portions 64 at a 45° angle until each leg portion 66 meets with the other. Accordingly, the intersection of the upper surfaces of leg members 66 define a 90° angle with respect to each other. Of course, the angular configuration of leg portions 66 with respect to each other may vary to include angles greater than or less than 90°.

In addition, the lower surface of end portions 64 is configured to have heat staking portions 68. Heat staking portions 68 provide the necessary material for staking retaining member 60 to the surface of fan 28. Heat staking portions 68 traverse the width of end portions 64. In an exemplary embodiment, heat staking portions 68 protrude 0.5 mm from the surface of end portions 64. Of course, the size configuration and number of heat staking portions 68 may vary.

In an exemplary embodiment, retaining member 60 has the following dimensions: 13 mm in length, 6 mm in width, and 4.8 mm in overall height. Each staking portion 68 protrudes 0.5 mm from the bottom surface of end portions 64. End portions 64 have the following dimensions: 3.5 mm x 1.25 mm x 6.0 mm.

Of course, the size, configuration, and dimensions of retaining member 60 may vary. For example, an alternative retaining member 60 is configured to have a more rectangular configuration, illustrated by the dashed lines in Figure 13. Of course, may other configurations, such as trapezoidal, parrellpiped etc. of retaining member 60 are contemplated in accordance with the present invention.

Accordingly, and through the use of retaining member 60, the removal of the slip ring assembly and replacement thereof with a new slip ring assembly, having unworn slip ring surfaces, is facilitated in a manner which allows for a secure attachment of the same. The point of attachment for the leads of the slip ring assembly and the leads of the coil is fixedly secured to the surface of fan 28. This allows alternator 10 to be rebuilt without having to remove any other parts other than the slip ring assembly. Of course, other wearable parts such as the brushes, which make contact with the surfaces of the slip ring assembly, may also be replaced during the rebuilding of the alternator.

While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.